

Association for Information Systems AIS Electronic Library (AISeL)

AMCIS 2010 Proceedings

Americas Conference on Information Systems
(AMCIS)

8-2010

Incorporating Temporal Structure Components to Electronic Temporal Coordination Systems

Dezhi Wu

CSIS Department Southern Utah University, wu@suu.edu

Follow this and additional works at: <http://aisel.aisnet.org/amcis2010>

Recommended Citation

Wu, Dezhi, "Incorporating Temporal Structure Components to Electronic Temporal Coordination Systems" (2010). *AMCIS 2010 Proceedings*. 119.

<http://aisel.aisnet.org/amcis2010/119>

This material is brought to you by the Americas Conference on Information Systems (AMCIS) at AIS Electronic Library (AISeL). It has been accepted for inclusion in AMCIS 2010 Proceedings by an authorized administrator of AIS Electronic Library (AISeL). For more information, please contact elibrary@aisnet.org.

Incorporating Temporal Structure Components to Electronic Temporal Coordination Systems

Dezhi Wu

CSIS Department
Southern Utah University
Cedar City, UT 84720, USA
wu@suu.edu

Benjamin Ngugi

School of Management
Suffolk University
Boston, MA 02108, USA
bngugi@suffolk.edu

ABSTRACT

Effective temporal coordination between individuals and organizations is becoming increasingly crucial in today's dynamic business environment. This coordination process typically involves a series of interactions among temporal structures, since temporal structures provide a possible explicit and implicit mechanism to structure activities across time and space. Organizations should be more proactively engaged in temporal coordination in order to ensure that temporal structures are now used to enhance and integrate business processes. However, the temporal structures have not been explicitly integrated into the current temporal coordination system. Therefore, through a temporal structure lens, this research was designed and carried out to identify what difficulties and challenges the individual users have with their current temporal coordination systems in their personal time management practices. Based on two sets of in-depth interview studies with a group of busy knowledge workers, a set of system recommendations to incorporate more extensive temporal structures was made, in order to enhance the current electronic coordination systems, such as personal and collaborative calendars.

Keywords

Time, temporal coordination, calendars, temporal structures, collaborative calendar systems

INTRODUCTION

Time is regarded as a major dimension of social organization and the temporal rigidity of work becomes one of the key structural characteristics of modern organizations (Zerubavel, 1981). It has been a challenging task to effectively coordinate time between individuals and organizations, since almost all the work takes place in a dynamic temporal context, which affects organizational productivity. The concept of temporal structures has been developed to control the temporal flow of activities within an organization. Giddens' (1986) structuration theory implies that actors often communicate in order to temporally structure their daily work practices. Temporal structures provide a possible explicit and implicit mechanism to structure activities across time and space, such as "temporal symmetry" (e.g., the activity synchronization among different individuals) and "temporal complementarity" (e.g., the differences of implementation strategy due to the task temporal sequencing) (Zerubavel, 1981). The coordination process typically involves a series of interactions among temporal structures depending on differences in goals, tasks, technologies in use and interests at both individual and organization levels (Im et al., 2005). We can therefore observe how individuals manage and coordinate their time through manipulating their work temporal structures.

Information technology can provide important tools in capturing and managing temporal structures. However, the discipline of information systems has only recently begun to take an interest in temporal structure research (Boland et al., 2004). Researchers are just beginning to understand what temporal structures exist and how they impact business processes. Most of the existing temporal structure research is still on the theory development stage and does not explore how information technology can be utilized to better support the temporal structure management process, which is referred to as temporal coordination in this research. The study presented in this paper makes a contribution to this body of research by gathering data on individual time management behavior with the purpose of enhancing the design of electronic temporal coordination systems.

The paper is structured as follows. The above introduction describes the motivation of this study. In the second section, we review previous work on temporal structures, temporal coordination and calendar tools. This is followed by a description of the research design and data analysis. Then we discuss the study findings and implications. Finally we propose the future directions of this work.

THEORETICAL BACKGROUND

Temporal Structures

Temporal structures have long been regarded as a complicated instrument of activating and structuring asynchronous differentiation to achieve organizational goals. Temporal structures are a primary concept in organizational behavior and management field (Bluedorn and Denhardt, 1988; Clark, 1985; Blount and Janicik, 2001; Orlikowski and Yates, 2002). Temporal structures are defined as a patterned organization of time used by humans to help them manage, comprehend, or coordinate their use of time (Wu, 2009). The temporal structures provide a foundation that human beings use to construct the regularity of their society, and reduce the uncertainty of the human perception of time. Individuals in a workplace experience different regular deadlines, engage in routine activities, and take seasonal vacations. However, how individual professionals respond to these temporal demands and entrainments set up by their organizations is not well known. A recent research study (Wu, 2009) was conducted to investigate the relationship between the quality of individual time management and temporal structure usage behavior. This study demonstrates that temporal structures are an important element of individual time management practices. These individual temporal experiences are a result of the ongoing temporal structures, which regulate an individual's time usage, and thus impact collective temporal coordination activities in organizations. Therefore, we argue that individual temporal structure usage behaviors help us better understand where ambiguous temporal boundaries are and how individuals handle time conflicts to achieve temporal coordination goals in personal time management practices. It is through this temporal lens that we generate new electronic temporal coordination features that can possibly improve both individual and organizational productivity.

Temporal Coordination

In personal time management practices, many activities involve temporal coordination, which is defined as temporal structure management involving coordination artifacts (e.g., calendars) in our research. Coordination theory (Malone and Crowston, 1990) and coordination mechanism (Schmidt and Simone, 1996) define coordination as interdependencies management among collective activities. Generally, a coordination process is composed of goals, activities, actors and interdependencies (Malone and Crowston, 1990). This coordination process involves identifying goals, mapping goals to detailed activities, selecting and assigning activities to actors, and managing interdependencies which refer to these goal-relevant relationships between the activities. Interdependent activities could be sequenced, paralleled or unstructured. They are often mixed with explicit and implicit temporal structures in nature. Explicit temporal structures (e.g., temporal goals - deadlines) can be easily coded in any temporal coordination systems, while implicit temporal structures (e.g. uncertain temporal coordination process involving multiple parties) require much more attention because of ambiguous temporal activity boundaries which are usually embedded in implicit organizational cultures.

Calendars

Calendars have long served as a useful temporal coordination aid for people to manage their time and coordinate many diverse activities both in the workplace and at home. Wu and Tremaine (2004) found that knowledge workers prefer electronic time management tools because of key features (e.g., search, visualization, sharing etc.) that make them more efficient to use. Palen (1999) found that organizational characteristics and work patterns impact the use of groupware calendars and individual time patterns. A few prior human-computer interaction studies have attempted to enhance computer user interfaces to better support temporal coordination activities. For example, an innovative interface technique called fisheye visualization was implemented in PDAs to overcome the small interface constraints by enlarging focused content in the center and shrinking other contents to the boundaries (Bederson et al., 2003). A transparency technique (Beard et al., 1990) was designed and implemented in a hospital scheduling system to better view temporal conflicts in order to support temporal coordination among hospital professionals. However, not many prior studies have explicitly used temporal structures as a notion with which to explore temporal coordination, and have considered issues that users have with managing temporal structures with their calendar tools. This is therefore our focus for this research.

RESEARCH DESIGN, PROCEDURE AND DATA ANALYSIS

Study Overview

Two sets of in-depth semi-structured interviews were conducted with twenty professionals in a US public research University. Data was collected on each individual's time management strategies and the types of temporal structures they experienced and used in their temporal coordination. The interviews were then analyzed for evidence of the different types of temporal structures that were in use.

Research Site

We selected a university setting for this research because a university typically has a large collection of conflicting time patterns. It is a complex environment with multiple departments setting their own temporal structures (e.g., when department meetings and seminars take place in addition to a seasonal cyclic structure that is imposed on the university by term start and end dates, and U.S. designated holidays). This research site should provide a rich and detailed collection of temporal management requirements.

Procedure

Twenty knowledge workers were recruited via emails. All were considered active and extremely busy employees of the university. Their roles ranged from busy department receptionist to university president and spanned a diverse set of occupations in between. The interviews lasted between thirty minutes and two hours.

The first set of interviews focused on short-term time management strategies (those involving the current day's scheduling and temporal coordination activities) and the second set of interviews focused on long-term time management strategies (those involving weekly, monthly and yearly scheduling and long-term temporal coordination plans). At no time in the interviews were temporal structures or norms mentioned. When the short-term time management interviews were conducted, each interviewee showed the interviewer the schedules recorded in their electronic temporal coordination tools (e.g. Outlook, PDA etc.). Using the interviewee's personal schedules, we asked them to explain how and why they scheduled and allocated time on specific meetings, events or other items found in their calendars or scheduled in their life for the coming week. Each interviewee was interviewed somewhat differently because of their different personal daily schedules.

Interview Data Analysis

All interviews were audio-taped and transcribed. The accuracy of transcription was checked by three researchers, and then the entire transcript was broken down to 475 coding units in a spreadsheet. Based on two previous temporal structure categorizations (Blount and Janicik, 2001; Orlikowski and Yates, 2002), a coding schema (Table 1) was then established to classify the individual temporal structures mentioned in the interviews into either explicit or implicit temporal structures. These were further broken down into clock-based, event-based, practice-based and socio-temporal norms. Using the coding schema designed for this research, two coders coded the transcripts of the interviews separately. We used Cohen's Kappa analysis to compute the intercoder reliability for our interview coding analysis, which was deemed satisfactory. The Cohen's Kappa value achieved for short-term time management practices was 0.868, and the Cohen's Kappa value on long-term time management strategies was 0.885.

Type of Temporal Structures	Coding Instructions
Explicit	The temporal structure can be explicitly coded, and the rules can be precisely written to describe its behavior in an external time structure.
<i>Clock-based</i>	The temporal structure uses the framework of minutes, hours, days, weeks and months for representing its structure, e.g., staff meetings are every Monday at 9 A.M.
<i>Event-based</i>	The temporal structure is organized around an event, e.g., sub-events that happen in relation to some main event that take place in a time structure governed by the main event, e.g., a bridal shower happens a month before the wedding.
Implicit	The temporal structure is internally known by one or more people. It may be involved with cultural behavior, e.g., how much time is allowed before someone is considered seriously late.
<i>Practice-based</i>	The temporal structure is a result of an established practice that people implicitly know, e.g., parents coordinate kids activities.
<i>Socio-temporal Norm</i>	The temporal structure is a result of a socially established and expressed rule for using time. It often involves cultural practices or social behaviors, e.g., the acceptable amount of time one can be late for an event.

Table 1. Temporal Structures Coding Schema

STUDY FINDINGS

Management respondents used multiple temporal structures for their daily life and work temporal coordination as seen from the interview data analysis. Some of them used more than one temporal coordination tools for managing their different temporal structures, e.g., one interviewee kept her husband's schedule on her PDA (which was private information). Because of this, she was unable to synchronize her PDA schedule with her publicly displayed calendar. Other respondents re-typed university schedule several times in their personal calendars. All respondents reported difficulty in maintaining multiple temporal structures. Some, especially new employees, reported difficulties with knowing about the university's temporal rhythms.

Figure 1 shows the distribution of personal temporal structure usage. We found that two main categories of temporal structure in use are explicit clock-based (57%) and implicit practice-based (30%). The least used temporal structures are the explicit event-based (8.4%) and the implicit socio-temporal norms (4.6%) temporal structures. The fact that explicit clock-based result are the most widely used can be attributed to the fact that most of the respondents were using some form of electronic temporal coordination system (i.e., calendar) to maintain their schedules and these systems only supported explicit clock-based temporal structures.

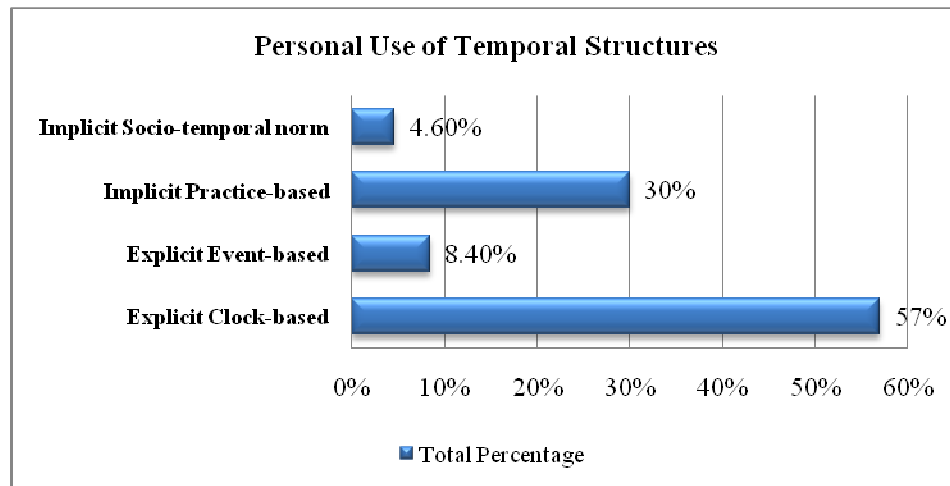


Figure 1. Coding Results of Personal Use of Temporal Structures

The coding analysis results suggest that implicit practice-based temporal structures are difficult to manage, since they did not have exact start and end times and therefore could not be placed in their current electronic temporal coordination system, which does not support this practice. For example, one of the secretaries in our survey placed reminders to call workmen on post-its attached to her computer containing the date that she had first called the physical plant, the date she had recalled, etc.

Complaints about schedule juggling arose when superiors imposed unplanned deadlines and meetings on our respondents. However, many of them reserved additional blocks of time anticipating these possibilities. One of the challenges of faculty members and staff was the assignment of time for events that had not as yet been scheduled, such as grant deadlines, conference deadlines, and academic calendar deadlines. Many of these deadlines changed by a week or two yearly and often conflicted with one another, so that planning course syllabi, faculty meetings, and other temporal structure related activities could not be precisely done in advance. This explained why most of the temporal planning involved implicit practice-based temporal structures. This was also explained as the biggest headache by our respondents because these structures required the highest juggling, which are considered most difficult temporal coordination activities.

The use of explicit event-based temporal structures was not as common but still prevalent. The managers knew the relationships between an existing planned event and the other activities that needed to be done to make sure the event took place, which is the core of coordinating interdependent activities. Often, only the event was recorded in the personal calendar but a post-it or to do list was generated associated with the event and then used to make sure that all the associated work was carried out.

Implicit socio-temporal norms were the next temporal structure that was used to a certain extent by our respondents. Some of the faculty respondents complained that when they came to work at the university, there were a large number of understood activities that took place that they were not aware of. Some of these involved weekend attendance at the university or afternoon attendance at a meeting. More seasoned faculty members were familiar with the approximate time of these events and also with an understanding of when it was a good idea to make a showing and when it was not. Other implicit socio-temporal norms that our respondents discussed were approximate time interludes. For example, how long should one wait between submission of an article and an editor's response. The current temporal coordination systems did not allow our respondents to put in approximate times or to keep track of elapsed time which was a big challenge.

STUDY CONTRIBUTIONS AND FUTURE RESEARCH

This study makes several contributions. First, the study provides a quantitative demonstration of the existence and distribution of these temporal structures as used in personal time management practices. Second, the study identifies several missing features in the current temporal coordination systems. Third, the study recognizes that many of the temporal structures that entrain managers' lives cannot be readily encoded in existing temporal coordination systems suggesting that the power of the computer in supporting temporal coordination is under-utilized.

The long term intent of this research and other related studies should be to develop a design for an electronic temporal coordination system that will allow users to view implicit as well as explicit temporal structures, to view time usage through multiple temporal structure lenses, to build event-based temporal structures through a rule-based system similar to Object-Lens (Lai and Malone, 1988) and to provide better software tools for sharing and copying temporal structures from the web or other resources. This requires capturing unknown but important temporal information residing in the human being's mind and implementing it to the tools.

This research captures temporal structure requirements for electronic coordination systems through exploring a variety of temporal structure usage behaviors in individual time management practices. Two potential approaches could be used to build such a system: (1) the first approach would involve making implicit temporal structure more explicit by transferring what is normally retained in the human mind into the temporal coordination tools. Some of the practice-based and social cultural norms are well known and can be transferred into explicit structures with more explicit rules set up for the system design. (2) The second approach would involve making the temporal coordination tools more intelligent by incorporating some of the new advances in artificial intelligence practices that has resulted into machines which can reason and make decisions either using well-established rules or by relying on statistical deductions. Further, the study identifies the fuzziness of temporal structures used by human beings as a continuing challenge. In this research, we analyzed and defined several temporal structures used by different professionals. Such structures are expected to form new requirements for future temporal coordination system design. Because of the large differences found in the types of temporal structures used, some temporal structures may need to be supported by electronic temporal coordination systems more than others. In addition, it should be noted that our study does not necessarily provide a complete distribution of the temporal structures in use by our respondents or the general population. Our study sample was small and the interview captured data at a point in time. Future research will address these limitations through exploring more diverse samples in other areas.

REFERENCES

1. Beard, D., Palaniappan, M., Humm, A., Banks, D., Nair, A., and Shan, Y. (1990) A visual calendar for scheduling group meetings, *Proceedings of the ACM Conference on Computer-Supported Cooperative Work*, 279-290.
2. Bederson, B., Clamage, A., Czerwinski, M.P., and Robertson, G. (2003) A fisheye calendar interface for PDAs: Providing overviews for small displays, *CHI Extended Abstracts*, 618-619.
3. Blount, S. & Janicik, G. A. (2001) When plans change: Examining how people evaluate timing changes in work organizations, *The Academy of Management Review*, 26, 4, 566-585.
4. Bluedorn, A. C. & Denhardt, R. B. (1988) Time and organization, *Journal of Management*, 14, 2, 299-320.
5. Boland, R., Jones, M., Levina, N., Orlikowski, W. and Wagner, E. (2004). Time, times, and timing: Taking temporality seriously in information systems research, *Proceedings of International Conference on Information Systems*, Washington, D. C.
6. Clark, P. A. (1985) A review of the theories of time and structure for organizational sociology, in: Research in the Sociology of Organizations, S. B. Bacharach and S. M. Mitchell (eds.), JAI, Greenwich, CT.
7. Giddens, A. (1986) *The Constitution of Society: Outline of the Theory of Structuration*, University of California Press.

8. Im, H., Yates, J. and Orlikowski, W. (2005) Temporal coordination through communication: Using genres in a virtual start-up organization, *Information Technology & People*, 18, 2, pp. 89-119.
9. Lai, K.-Y. & Malone, T. W. (1998) Object lens: A "spreadsheet" for cooperative work, *Proceedings of the ACM CSCW'88 Conference on Computer-Supported Cooperative Work*, 115-124.
10. Malone, T. and Crowston, K. (1990) What is coordination theory and how can it help design cooperative work systems? *Proceedings of the Conference on Computer-Supported Cooperative Work*, Los Angeles, CA, ACM Press, 357-370.
11. Orlikowski, W. J. & Yates, J. (2002) It's about time: Temporal structuring in organizations, *Organization Sciences*, 13,6, 684-700.
12. Palen, L. (1999). Social, individual & technological issues for groupware calendar systems. *Proceedings of the ACM Conference on Human Factors in Computing Systems*, 17-24.
13. Schmidt, K. and Simone, C. (1996) Coordination mechanisms: Towards a conceptual foundation of CSCW system design, *Computer Supported Cooperative Work*, 5, pp. 155-200.
14. Wu, D. & Tremaine, M. (2004) Knowledge worker adoption of time management tools: Satisfaction and perceived effectiveness, *Proceedings of the Tenth Americas Conference on Information Systems*, New York City, NY, 3444 - 3453.
15. Wu, D. (2009) *Temporal structures in individual time management: Practices to enhance calendar tool design*, IGI Global Publishing, August 2009, ISBN: 978-1-60566-776-8.
16. Zerubavel, E. (1981) *Hidden Rhythms: Schedules and Calendars in Social Life*. Chicago: University of Chicago Press.